

# EXTOXNET

## Extension Toxicology Network

### Pesticide Information Profiles

A Pesticide Information Project of Cooperative Extension Offices of Cornell University, Oregon State University, the University of Idaho, and the University of California at Davis and the Institute for Environmental Toxicology, Michigan State University. Major support and funding was provided by the USDA/Extension Service/National Agricultural Pesticide Impact Assessment Program.

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## PYRETHRINS AND PYRETHROIDS

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**TRADE OR OTHER NAMES:** Several trade names associated with these compounds are Buhach, Chrysanthemum Cinerariaefolium, Ofirmotox, Insect Powder, Dalmation Insect Flowers, Firmotox, Parexan and NA 9184.

**INTRODUCTION:** Pyrethrins are natural insecticides produced by certain species of the chrysanthemum plant. The flowers of the plant are harvested shortly after blooming and are either dried and powdered or the oils within the flowers are extracted with solvents. The resulting pyrethrin containing dusts and extracts usually have an active ingredient content of about 30%. These active insecticidal components are collectively known as pyrethrins. Two pyrethrins are most prominent, pyrethrin-I and pyrethrin-II. The pyrethrins have another four different active ingredients, Cinerin I and II and Jasmolin I and II. Pyrethrin compounds have been used primarily to control human lice, mosquitoes, cockroaches, beetles and flies. Some "pyrethrin dusts," used to control insects in horticultural crops, are only 0.3% to 0.5% pyrethrins, and are used at rates of up to 50 lb/A. Other pyrethrin compounds may be used in grain storage and in poultry pens and on dogs and cats to control lice and fleas.

The natural pyrethrins are contact poisons which quickly penetrate the nerve system of the insect. A few minutes after application, the insect cannot move or fly away. But, a "knockdown dose" does not mean a killing dose. The natural pyrethrins are swiftly detoxified by enzymes in the insect. Thus, some pests

will recover. To delay the enzyme action so a lethal dose is assured, organophosphates, carbamates, or synergists may be added to the pyrethrins.

Semisynthetic derivatives of the chrysanthemumic acids have been developed as insecticides. These are called pyrethroids and tend to be more effective than natural pyrethrins while they are less toxic to mammals. One common synthetic pyrethroid is allethrin.

In this report, the term "pyrethrins" refers to the natural insecticides derived from chrysanthemum flowers; "pyrethroids" are the synthetic chemicals, and "pyrethrum" is a general name covering both compounds. The EPA classifies pyrethrin-I as a Restricted Use Pesticide (RUP). Restricted Use Pesticides may be purchased and used only by certified applicators.

## **TOXICOLOGICAL EFFECTS**

- Acute Toxicity:** Synthetic pyrethroid compounds vary in their toxicity as do the natural pyrethrins. Pyrethrum carries the signal word CAUTION. Inhaling high levels of pyrethrum may bring about asthmatic breathing, sneezing, nasal stuffiness, headache, nausea, incoordination, tremors, convulsions, facial flushing and swelling, and burning and itching sensations (102). The most severe poisonings have been reported in infants, who are not able to efficiently break down pyrethrum. The lowest lethal oral dose of pyrethrum is 750 mg/kg for children and 1,000 mg/kg for adults (102). Oral LD50 values of pyrethrins in rats range from 200 mg/kg to greater than 2,600 mg/kg (96). Some of this variability is due to the variety of constituents in the formulation. Mice have a pyrethrum oral LD50 of 370 mg/kg (102). Animals exposed to toxic amounts may experience tongue and lip numbness, nausea, and diarrhea. Symptoms may also include incoordination, tremors, convulsions, paralysis, respiratory failure, and death. Pyrethroids can cause two quite different responses at near lethal doses in rats; aggressive sparring and a sensitivity to external stimuli progressing to tremors is the one response and pawing and burrowing behavior, and salivation leading to chronic seizures is the other (105). Human response to these two different types of pyrethroids has not yet been evaluated. Recovery from serious poisoning in mammals is fairly rapid. Rats and rabbits are not affected by large dermal applications (96, 102). On broken skin, pyrethrum produces irritation and sensitization, which is further aggravated by sun exposure.
- Chronic Toxicity:** Absorption of pyrethrum through the stomach and intestines and through the skin is slow. However, humans can absorb pyrethrum more quickly through the lungs during respiration. Response appears to depend on the pyrethrum compound used. Overall, pyrethrins and pyrethroids are of low chronic toxicity to humans and the most common problems in humans have resulted from the allergenic properties of pyrethrum (104). Patch tests for allergic reaction are an important tool in determining an individual's sensitivity to these compounds. Many of the natural and synthetic compounds can produce skin irritation, itching, pricking sensations and local burning sensations. These symptoms may last for about two days (105).
- Reproductive Effects:** Rabbits that received pyrethrins orally at high doses during the sensitive period of pregnancy had normal litters. A group of rats fed very high levels of pyrethrins daily for three weeks before first mating had litters with weanling weights much lower than normal (96).

Overall, pyrethrins appear to have low reproductive toxicity.

- **Teratogenic Effects:** The one rabbit reproduction study performed showed no effect of pyrethrins on development of the offspring (101). More information is needed.
- **Mutagenic Effects:** No information was found.
- **Carcinogenic Effects:** No carcinogenic status has been established for pyrethrins or pyrethroids.
- **Organ Toxicity:** In mammals, tissue storage has not been recorded. At high doses, pyrethrum can be damaging to the central nervous system and the immune system. When the immune system is attacked by pyrethrum, allergies can be worsened. Animals fed large doses of pyrethrins may experience liver damage. Rats fed pyrethrin at high levels for two years showed no significant effect on survival, but slight, definite damage to the livers was observed (96). Inhalation of high doses of pyrethrum for 30 minutes each day for 31 days caused slight lung irritation in rats and dogs (102).
- **Fate in Humans and Animals:** Pyrethrins, pyrethroids, and their metabolites are not known to be stored in the body nor excreted in the milk (100). The urine and feces of people given oral doses of pyrethrum contain chrysanthemumic acid and other metabolites (100, 96). These metabolites are less toxic to mammals than are the parent compounds (101). Pyrethrins I and II are excreted unchanged in the feces (100). Other pyrethrum components undergo rapid destruction and detoxification in the liver and gastrointestinal tract (96).

## ECOLOGICAL EFFECTS

Pyrethrin is extremely toxic to aquatic life, such as bluegill and lake trout while it is slightly toxic to bird species, such as mallards. Toxicity increases with higher water temperatures and acidity. Natural pyrethrins are highly fat soluble, but are easily degraded and thus do not accumulate in the body. These compounds are toxic to bees also. Because pyrethrin-I, pyrethrin-II, and allethrin have multiple sites in their structures that can be readily attacked in biological systems, it is unlikely that they will concentrate in the food chain (100).

## ENVIRONMENTAL FATE

Two pyrethroid synthetic insecticides, permethrin and cypermethrin, break down in plants to produce a variety of products (103). Pyrethrins have little residual effect. In stored grain, 50% or more of the applied pyrethrins disappear during the first three or four months of storage. At least 80% of what remains is removed by handling, processing, and cooking (101). Pyrethrins alone provide limited crop protection because they are not stable. As a result, they are often combined with small amounts of antioxidants to prolong their effectiveness. Pyrethrum compounds are broken down in water to nontoxic products. Pyrethrins are inactivated and decomposed by exposure to light and air. Pyrethrins are also rapidly decomposed by mild acids and alkalis. Stored pyrethrin powders lose about 20% of their potency in one year. As the pyrethrins are purified, their stability decreases; thus, pure pyrethrin-I and pyrethrin-II are the least stable of the pyrethrins (96). Purified pyrethrins are very expensive and are only available for laboratory uses.

## **PHYSICAL PROPERTIES AND GUIDELINES**

### **Physical Properties:**

- **Appearance:** The pyrethrins are viscous brown resins, liquids, or solids which inactivate readily in air.
- **Chemical Name:** n/a
- **CAS Number:** 8003347
- **Molecular Weight:** Due to differences in the types and amounts of esters in the pyrethrum mixture, its molecular weight ranges from 316 to 374.
- **Water Solubility:** considered to be insoluble in water.
- **Solubility in Other Solvents:** soluble in organic solvents like: alcohol, kerosene, nitromethane, petroleum ether, carbon tetrachloride, and ethylene dichloride.
- **Melting Point:** n/a
- **Vapor Pressure:** about 0 mm/Hg
- **Partition Coefficient:** n/a
- **Adsorption Coefficient:** n/a

### **Exposure Guidelines:**

- **ADI:** 0.04 mg/kg body weight (humans) (101)
- **MCL:** Not Available
- **RfD:** Not Available
- **PEL:** 5 mg/m<sup>3</sup>
- **HA:** Not Available
- **TLV:** 5 mg/m<sup>3</sup>

## **BASIC MANUFACTURER**

There are several manufacturers of products in this category.

## **REFERENCES**

References for the information in this PIP can be found in Reference List [Number 2](#)

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**DISCLAIMER:** The information in this profile does not in any way replace or supersede the information on the pesticide product label/ing or other regulatory requirements. Please refer to the pesticide product label/ing.